Physical activity was assessed between 2006 and 2008 by questionnaire, while low back pain and disability were assessed by the Chronic Pain Grade Scale at the time of MRI. Intervertebral disc height and cross-sectional area and fat content of multifidus and erector spinae were assessed from MRI.

Results: Lower physical activity levels were associated with reduced average intervertebral disc height (β -0.63mm, 95% CI -1.17mm to -0.08mm, $p = 0.026$) after adjusting for age, gender and BMI. There were no significant associations between physical activity levels and the cross-sectional area of multifidus or erector spinae. Lower levels of physical activity were associated with an increased risk of high fat content in multifidus (OR 2.7, 95% CI 1.1 to 6.7, $p = 0.04$) and high intensity pain/disability (OR = 5.0, 95% CI 1.5 to 16.4, $p = 0.008$) after adjustment for age, gender and BMI.

Conclusions: Physical inactivity is associated with reduced intervertebral disc height, high fat content of multifidus and high intensity low back pain and disability in a dose-dependent manner.

These data provide evidence that among community-based adults, physical inactivity is associated with deleterious changes in lumbosacral spine structure.

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THE ASSOCIATIONS BETWEEN DISC DEGENERATION AND CO-EXISTENT STRUCTURAL ABNORMALITIES IN THE LUMBOSACRAL SPINE – A 3.0T MRI STUDY OF COMMUNITY-BASED ADULTS

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Purpose: Degenerative disc disease of the lumbar spine is common, with severe disease increasing the risk for back pain. This cross-sectional study examined whether disc degeneration was associated with structural pathology in the lumbosacral spine.

Methods: 72 community-based individuals not selected for low back pain had MRI to determine lumbosacral disc degeneration via the Pfirrmann grading system, intervertebral disc height, Modic change and paraspinal muscle fat content.

Results: With reducing intervertebral disc height, there was an increased prevalence of degenerative disc disease from L3 through to S1 (OR range 1.3 to 1.5; 95% CI range 1.1 to 2.1; all $p \le 0.01$). Modic change from L2 to L4 was associated with an increased prevalence of disc degeneration at each corresponding level (OR range 5.5 to 31.3, $p \le 0.04$). High fat (>50%) content of multifidus and erector spinae were associated with an increased prevalence of intervertebral disc degeneration at L5/S1 (OR 4.5, 95% CI 1.3 to 15.2, $p = 0.016$) and L3/4 (OR 6.4, 95% CI 1.3 to 31.8, $p = 0.02$) respectively, with a non-significant, but similar direction for all other lumbosacral levels.

Conclusions: This cross-sectional study has demonstrated that reduced intervertebral disc height, Modic change and high fat content of the paraspinal muscles are associated with an increased prevalence of severe degenerative disc disease in the lumbosacral spine. Longitudinal studies are required to help determine whether degenerative disc disease is a cause or result of these structural abnormalities.

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MODIC CHANGES IN THE LUMBAR SPINE AND THEIR ASSOCIATION WITH BODY COMPOSITION, FAT DISTRIBUTION AND INTERVERTEBRAL DISC HEIGHT – A 3.0T-MRI STUDY OF COMMUNITY-BASED ADULTS

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Purpose: Vertebral endplate and bone marrow (Modic) change are being recognised in the pathogenesis of non-specific low back pain.

Although obesity, measured by the Body mass index (BMI), has not been found to be associated with Modic change, body composition and fat distribution have not been examined. Moreover, no study has examined whether Modic change are related to other structural features of low back pain, such as reduced intervertebral disc height.

Methods: 72 community-based individuals not selected for low back pain had lumbar vertebral Modic change and intervertebral disc height assessed from MRI. Dual energy x-ray absorptiometry measured body composition and fat distribution.

Results: The predominance of Modic change was type 2, with only 1 participant demonstrating Modic type 1 change. Modic change was associated with an increased fat mass index (OR 1.20, 95% CI 1.01 to 1.43), and tended to be associated with a reduced fat-free mass index (OR 0.62, 95% CI 0.37 to 1.03, $p = 0.07$). While an increased percentage of gynoid fat was associated with a reduced risk (OR 0.62, 95% CI 0.43 to 0.89), an increased percentage of android fat was associated with an increased risk of Modic change (OR 2.11, 95% CI 1.18 to 3.76). Modic change was also associated with reduced intervertebral disc height at L2/3, L4/5 and L5/S1 (OR range 1.4 to 1.8; all $p \le 0.03$).

Conclusions: Modic type 2 change is associated with reduced intervertebral disc height and an increased fat mass index. Whereas gynoid fat distribution protected against Modic type 2 change, an android pattern increased the risk of this lesion.

Modic type 2 change, which histologically represent fat replacement, might have a metabolic component to its aetiology.

Imaging: Joint Morphometry

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BONE MARROW LESIONS QUANTITATIVELY EVALUATED ON FLUID SENSITIVE SEQUENCES, NOT CARTILAGE SEQUENCES, CORRELATE WITH PAIN: DATA FROM THE OSTEOARTHRITIS INITIATIVE

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Purpose: Subchondral bone marrow lesions (BMLs) are common findings on magnetic resonance (MR) images of knees with osteoarthritis (OA) and relate to structural and symptomatic progression of OA. While BMLs are often assessed on intermediate-weighted fat suppressed (IW FS) turbo spin echo sequences some researchers have also evaluated BMLs on 3-dimensional dual echo steady state (3D DESS) sequences or other similar sequences that are used for cartilage measurements. This latter approach would enable an efficient method to assess changes in BMLs and cartilage on the same sequence. Prior head-to-head comparisons have demonstrated that IW FS sequences may be more sensitive to detecting BMLs but have not determined if BMLs on the different sequences have similar construct validity. The purpose of this study was to compare quantitative assessment of BMLs on IW FS and 3D DESS sequences and to assess the construct validity of BML volumes on each sequence by calculating the correlations between BML volumes and knee

Methods: We randomly chose 30 knees from the Osteoarthritis Initiative (OAI) with 24- and 48-month MR images as well as complete data from the OAI Bone Ancillary Study (i.e., subchondral bone mineral density, MR-based trabecular morphometry, meniscal readings, and cartilage damage). Fifteen of these were randomly selected among those with medial joint space narrowing (OARSI score) between the 24- and 48-month OAI visits and 15 knees had no medial joint space narrowing during this observation period. All of the knees had both IW FS and 3D DESS MRI images. The IW FS turbo spin echo and 3D DESS sequences were acquired using the OAI MR imaging protocol. We designed a semi-automatic software to measure BMLs on both sequences (Figure 1). One reader used customized software to place a large region of interest around a BML and the software generated the BML boundaries based on image morphology algorithms (image normalization, filtering, dilation, noise removal, and thresholding). We decided one threshold for IW FS and one threshold for 3D DESS based on 4 sample MRIs from each sequence. We summed the femur and tibia BMLs to generate a whole knee BML volume. We calculated the Spearman correlations of 24-month BML volume and BML volume change (48-month BMLs minus 24-month BMLs) between IW FS and 3D DESS sequences. We also calculated the association of BMLs on both sequences with Western Ontario and McMaster universities Arthritis index (WOMAC) pain score.

Results: The IW FS sequence has larger BML volumes than 3D DESS sequence (24-month BMLs mean: IW FS = 3507mm^3, SD = 5130mm^3; 3D DESS = 564.9mm^3, SD = 692.80mm^3; Figures 2a and 2b). The difference in BML volumes between sequences is greater among knees with larger BMLs than knees with smaller BMLs (Figure 2b). The IW FS sequence generally demonstrates more BMLs volume change than 3D DESS sequence (Figure 2c and 2d). Furthermore, the difference between BML volume change between sequences is greater among knees with larger BML volume changes. The 24-month BML volume on IW FS is correlated with the 24-month BMLs volume on 3D DESS ($r = 0.90$, p <

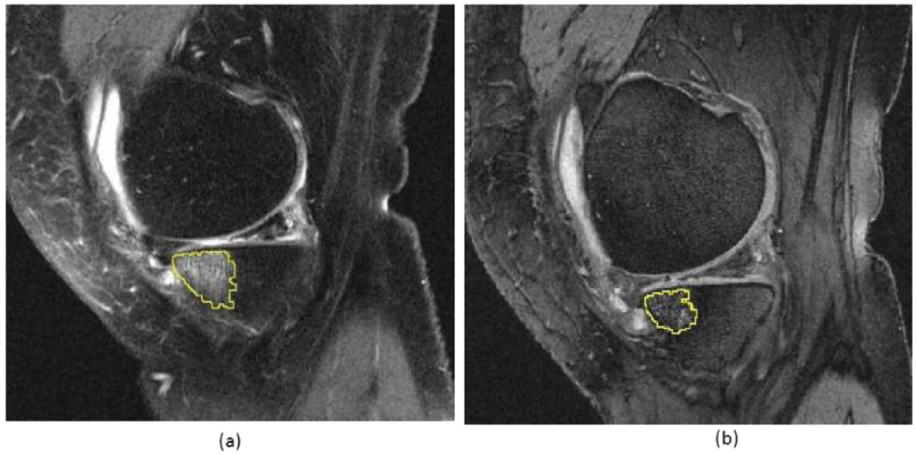

Figure 1(a) BML on IW FS sequence, (b) Same BML on 3D DESS sequence.

0.001). The BMLs volume change on IW FS is correlated with the BMLs volume change on 3D DESS ($r = 0.53$, $p = 0.0025$). The 24-month WOMAC pain is correlated with the 24-month 3D BMLs on IW FS ($r = 0.41$, $p = 0.024$, Figure 3a), but not the 24-month BMLs on 3D DESS ($r = 0.28$, $p = 0.14$, Figure 3b). While not statistically significant, there was a trend that change in WOMAC pain was correlated with BML volume change on IW FS ($r = 0.34$, $p = 0.06$, Figure 3c) but not with BML volume change on 3D DESS ($r = -0.09$, $p = 0.63$, Figure 3d).

Conclusions: Generally, BMLs exist on both IWFS and 3D DESS sequences. There is a high association of BML volumes on both sequences at baseline but the association is smaller when assessing BML volume change. IW FS usually has larger BML volumes than DESS sequence and may be more sensitive to change, particularly when there is a large BML volume change. The quantitative BMLs measurement on IW FS also provided larger correlation coefficients with pain than the 3D DESS. Overall, these results highlight the challenge of using a DESS sequence to measure BMLs. While it is feasible it would likely underestimate BML size, BML change, and some associations (e.g., with knee pain).

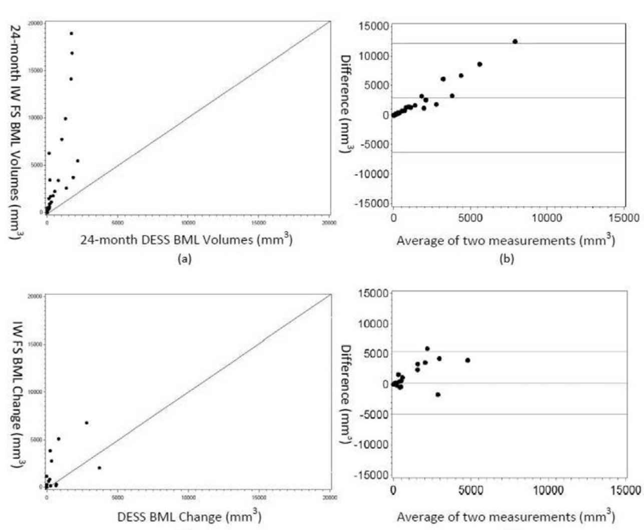

Figure 2(a) Scatter plot of baseline BML volumes on two sequences, (b) Bland-Altman plot of baseline BMLs. (c) Scatter plot of BML volume change on two sequences, (d) Bland-Altman plot of follow-up BMLs.

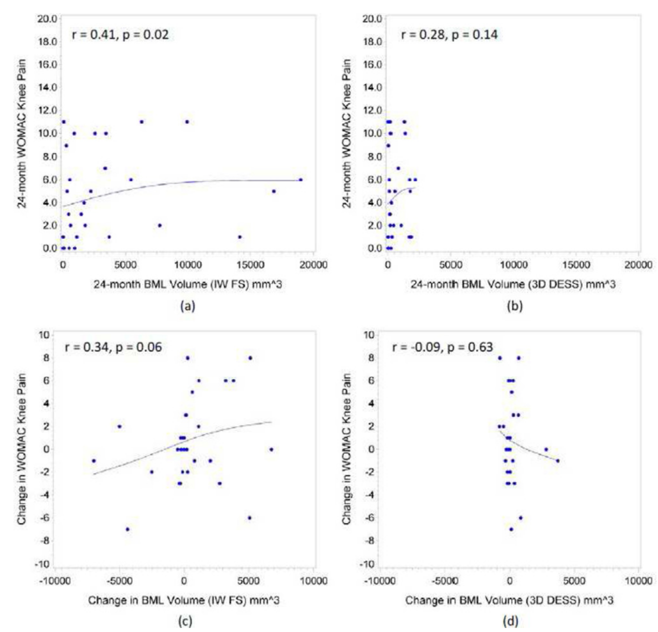

Figure 3. Scatter plots between 24-month pain and 24-month bone marrow lesion (BML) volume (a. IW FS sequence, b. 3D DESS sequence) as well as change in pain and change in BML volume (c. IW FS sequence, d. 3D DESS sequence).

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VARIATION IN KNEE SHAPE PREDICTS THE FUTURE ONSET OF RADIOGRAPHIC KNEE OSTEOARTHRITIS (RKOA) AND THIS VARIATION IS DIFFERENT IN MALES COMPARED TO FEMALES

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Purpose: While it is well known that the burden of knee OA is significantly greater in women as compared to men, the exact etiology of this sex difference is not well understood. It has been hypothesized that the complex interaction between risk factors (varus alignment, joint congruency, cartilage thickness, and soft tissue damage), and knee joint